

REMARKS

The Office Action mailed June 22, 2010, has been received and its contents carefully noted. The pending claims, claims 1, 2 and 5–13, were rejected. By this Response, claims 1 and 13 have been amended. Support may be found in the specification and the claims as originally filed. See, for example, Figures 3 and 4 and the corresponding text of the specification. No statutory new matter has been added. Therefore, reconsideration and entry of the claims, as amended, are respectfully requested.

Interview Summary

Applicants appreciate the Examiner taking the time to conduct a telephonic interview on September 6, 2010. During the interview, Applicants representatives proposed amending the claims to explicitly recite “a step-wise transition between the lead-out passage and the injection port”. The Examiner acknowledged that such was supported by Figure 4. Applicants then explained that the cited documents do not teach or suggest the combination of (1) the step-wise transition, and (2) the relative dimensions of the cross-sectional areas S_a , S_b , and S_c . The Examiner recommended that Applicants explicitly detail why the cited documents do not suggest such a step-wise transition, the dimensions of the cross-sections, and the benefits resulting therefrom. The Examiner recommended that Applicants explain why optimizing the features of Hirose and Tateyama would not have led one of ordinary skill in the art to features (1) and (2) above.

Applicants again appreciate the Examiner's time and thoughtful consideration.

The Claimed Invention

The present invention is directed to a two-fluid nozzle having a step-wise transition between the lead-out passage and the injection port. As described in paragraph [0022] of the specification, the injection port 24 is formed in an orifice shape with a (uniform) cross-sectional area smaller than that of the lead-out passage 23 (see FIG 3, FIG 4). Thus, even when liquid droplets grow large as they travel along the inner wall of the lead-out passage 23, while passing through the lead-out passage 23, the large liquid drops are atomized again into plural and smaller

liquid droplets as they pass through the step-wise transition between the lead-out passage and the injection port 24.

Applicants' nozzle structure is advantageous because, as described in paragraphs [0004] and [0005] of the specification, large liquid drops injected onto the surface of a wafer may damage the surface of the wafer. In addition, when there are large differences in the injection speeds of drops, slow moving liquid drops decrease the cleaning effect, and fast moving liquid drops damage the surface of the wafer.

The present invention provides a two-fluid nozzle which regulates liquid droplets to have not only uniform diameters, but also substantially uniform speeds. As set forth in paragraph [0023] of the instant specification, (1) the injection port has no roundness or tapered face, (2) the cross-sectional area S_b of the injection port is constant from its beginning to its end, and (3) the cross-sectional area S_b is smaller than the cross-sectional area S_a of the lead-out passage. Because of the step-wise transition between cross-sectional areas S_a and S_b , and the cross-sectional areas themselves, as described in paragraph [0044] and FIG. 4, large liquid drops divide into plural liquid droplets in the injection port and thus the number of liquid droplets increases. Hence, a large number of fine-particle liquid droplets are injected toward the wafer at a favorable injection speed. Because of the cylindrical shape of the injection port, and the relative cross-sectional areas, large droplets do not form along its interior walls and fine-particle liquid droplets are injected with due intensity onto the surface of the wafer, at uniform speeds to thereby improve contaminant removal while preventing wafer damage.

Rejection under 35 U.S.C. 103(a)

The Examiner rejected claims 1-2 and 5-13 under 35 U.S.C. 103(a) as being unpatentable over Hirose (US 20030079764) in view of Tateyama (JP 2001252604). The rejection is traversed.

Hirose also discloses a two-fluid nozzle for cleaning. However, Hirose's "passage 45a" has a constant cross-sectional area (FIG. 7) from the upper end to the opening at the lower end where mixed N_2 and water are output. There is no description about a particular shape of the injection port at the lower end, and its cross-sectional area. When the cross-sectional area of the passage is constant as shown in FIG. 7, liquid drops easily grow along the inner wall while

passing through the lead-out passage. This effect is described in paragraph 0078 of the present application is specification. Nowhere does Hirose teach or suggest (i) a step-wise transition between the lead-out passage and the injection port (ii) and cross-sectional areas Sa, Sb, and Sc, which, together, re-atomize large drops forming along the inner wall of the lead-out passage to output uniform smaller droplets having uniform speeds at the injection port.

Tateyama does not alleviate the deficiencies of Hirose. Tateyama describes a nozzle for injecting "liquid", not a nozzle for injecting "liquid drops". Nowhere does Tateyama teach or suggest a stepwise transition from a lead out passage to an injection port. As described in paragraph [0042] of Tateyama, the discharge mouth 63 is shaped such that its outer diameter is gradually reduced. This is to prevent the porous body 64, having a water retention ability and provided for preventing dripping of liquid, from falling when the treatment solution is discharged as described in the paragraph 0043. In addition, Tateyama discloses that "the inner diameter of the discharge mouth 63 may be equal to or greater than that of the solution sending pipe 61". Nowhere does Tateyama teach or suggest Applicants' recited relationships of cross-sectional areas for their lead-out passage and their injection port. Thus, Tateyama does not teach or suggest cross-sectional areas Sa, Sb, (and Sc) as set forth in the instant claims. Further, Applicants understand that since the nozzle of Tateyama is provided with a porous body 64, they expect that liquid passing through the liquid-sending pipe 61 cannot be accelerated and injected through the discharge mouth 63.

Because neither Hirose nor Tateyama teach or suggest (i) a stepwise transition between the lead-out passage and the injection port, and (ii) the cross-sectional areas Sa, Sb, and Sc as set forth in the instant claims, the combination of Hirose and Tateyama can not result in the claimed invention as a whole. Thus, the claimed invention is novel and unobvious.

Therefore, Applicants respectfully submit that the claims, as amended, are unobvious and the rejection under 35 U.S.C. 103(a) should be withdrawn.

Request for Interview

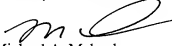
A telephonic or an in-person interview is respectfully requested should there be any remaining issues.

CONCLUSION

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Therefore, it is respectfully requested that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. It is believed that a full and complete response has been made to the outstanding Official action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

It is not believed that extensions of time are required, beyond those that may otherwise be provided for in accompanying documents. However, in the event that additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. 1.136(a), and any fees required therefor are hereby authorized to be charged to **Deposit Account No. 02-4300, Attorney Docket No. 033082M341.**

Respectfully submitted,
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